

The University of Chicago

THE INTELLIGENCE QUOTIENT AS
A FACTOR IN THE WHOLE-
PART PROBLEM

A PART OF THE DISSERTATION SUBMITTED
TO THE GRADUATE FACULTY IN CANDIDACY
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF PSYCHOLOGY

By
GRACE OBERSCHELP McGEOCH

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INTRODUCTION

The conflicting experimental data on the whole-part problem have suggested with a high degree of probability that the relative efficiency of the whole and part methods of learning is a function of a number of variable experimental conditions, such as method of measuring learning efficiency, material, subjects, type of part method used, and practice. As a consequence, some of the later investigators have arranged their experiments so as to test systematically the possible influence of some such factor. A few studies have indicated that the intelligence of the subject is a factor in the relative value of the two methods.

In 1902, Larguier des Bancel's¹ suggested, on the basis of results of poetry learning by one subject with a poor memory and weak attention: "Il est possible que, chez un sujet, incapable de saisir facilement un ensemble d'une certaine importance, la méthode globale perde sa supériorité."

In Neumann's study,² published in 1907, the whole method was consistently superior to the pure part with 5 nine- and ten-year old subjects in the learning and retention of 7 French-German pairs, and with 1 nine-year old subject with 8 Latin-German pairs, when reverse association was tested. He concluded from a qualitative analysis of each subject's results that the superiority of the whole method is a function of the general ability and goodness of memory of the subject: "Bei den begabteren und leichter lernenden Vpp. zeigte er (der

¹ J. Larguier des Bancel's, Sur les méthodes de mémorisation, *L'Année Psychol.*, 1902, 8, 201.

² G. Neumann, Experimentelle Beiträge zur Lehre von der Ökonomie und Technik des Lernens, *Die experimentelle Pädagogik*, 1907, 4, 172.

Vorzug der G-Methode) sich sofort deutlich, während bei den schwer lernenden Vpp. erst im Laufe der Übung eine Differenzierung der Lernweisen zu gunsten von G eintrat."

The factor of mental ability was again dealt with by Müller,³ in 1911, in his experiment on the learning and retention of 4 and 8 lines of poetry, and 8, 10 and 12 nonsense syllables and 8 words by 11 mentally weak subjects, from 11 to 32 years of age, all of whom were subnormal in intelligence and some of whom were suffering from mental disorder. With few exceptions, a part method was superior to the whole in both learning and retention. He concluded that mentally weak subjects, unlike normal individuals, learn better by parts than by wholes.

In 1926, Pechstein⁴ published results of 'an original attempt to determine the relation between intelligence levels and learning under the whole-part methodology.' His subjects, 12 eighth grade school children of unstated chronological ages, were divided into two equal groups, a bright group whose I.Q. range was from 125-136, and a dull group with an I.Q. range from 80-93. Each group learned seven different lengths of poetry selections (6, 8, 12, 14, 16, 18 and 21 lines) by four different methods, whole, pure part, progressive part and repetitive part. He drew "two very definite conclusions: 1. Some form of the part method is best for this type of learning. 2. The intelligence quotient is an essential factor in learning, learners of high intelligence being better able to employ the whole method successfully than are learners of lower intelligence levels. The lower the level, the more difficult to learn by the whole method, and the more ineffective it becomes." Pechstein's data are not statistically treated and no individual records are published. An analysis of the average time scores given shows that his two conclusions are unwarranted. Seven comparisons (seven different lengths of material) between the repetitive part method, which

³ H. Müller, Zur Ökonomie des Lernens bei geistesschwachen Personen, *Sommer's Klin. f. psych. u. nerv. Krankh.*, 1911, 6, 121-157.

⁴ L. A. Pechstein, The whole versus part methods in learning: comparison and summary, *Stud. in Educ.* (Yrbk. Natl. Soc. Coll. Teach. Educ., Univ. of Chicago Press), 1926, 15, 181-186.

is the most efficient of the four methods used according to the published tables, and the whole method yield the following results: with the bright group, the repetitive part is superior to the whole in 4 out of 7 comparisons but the average difference between the two methods is $\frac{1}{2}$ percent in favor of the whole; with the dull group, the repetitive part is superior to the whole in 5 out of 7 comparisons, and has an average advantage of 10 percent. It is very doubtful, on the basis of these results, whether there are any reliable differences between the four learning methods *within* each group, much less reliable differences *between* groups.

Sawdon⁵ pointed out in 1927 that Winch's data⁶ on the learning of four short poems and two long ones by three groups of subjects, 19, 26 and 10 pairs of school children with an average age of 11-6, 12-8 and 13-1 respectively, show that the advantage of the progressive part method decreases with an increase in age, school grade and memorizing ability of the subject. On the basis of this analysis, Sawdon enunciates "the conclusion which Winch hints at but does not definitely formulate, that the greater the mental development the more will the 'whole' method tend to show its value." Although the comparisons upon which this conclusion is based are relatively few, the statistical validity and consistency of Winch's data argue for the probability that 'mental development' (as measured in terms of age, school grade and memorizing ability) is a factor in the relative efficiency of the whole and part methods.

PROBLEM

The present study is an attack upon the problem: Is the relative efficiency of the whole, progressive part and pure part methods in learning and retention a function of the intelligence quotient of the subject? The method employed is that of group comparison. The average scores of a gifted group are compared with the average scores of a normal group

⁵ E. W. Sawdon, Should children learn poems in wholes or in parts?, *Forum of Educ.*, 1927, 5, 182-186.

⁶ W. H. Winch, Should poems be learnt by school children as 'wholes' or in 'parts'?, *Brit. J. Psychol.*, 1924, 15, 64-79.

in the learning and retention of two types of material with three different methods under the same experimental conditions. The subjects, who were equally divided between the sexes, were school children of chronological ages from 9 yrs., 0 mos. to 10 yrs., 11 mos. The I.Q. of each child was computed on the basis of the Stanford Revision of the Binet-Simon Intelligence Test which had been administered by the writer.

SUBJECTS

The 33 children, 17 girls and 16 boys, who constituted the gifted group were of the mental level which Terman has classified as 'near genius or genius,' *i.e.* I.Q. 140 and above. The mean chronological age of the group was 9-9, and the mean I.Q. 151.2 with a 40 point range, between I.Q. 140 and I.Q. 180. The relatively small number of gifted subjects used is a function of the great infrequency of their occurrence in the child population. The group of gifted children studied by Terman *et al.*,⁷ who ranged in age from 2 yrs., 4 mos. to 13 yrs., represented less than one half of one percent (643 out of 159,812) of the juvenile population surveyed for the study, while Hollingworth⁸ estimated that children with an I.Q. of over 180 occur perhaps a little more frequently than once in a million. The suggestions made by Terman and Hollingworth concerning the quickest and easiest method of finding gifted children were followed. The survey included private schools and only those public schools in the best residential districts of St. Louis and suburbs where the following children were tested: the child who had made the highest, or almost the highest, score in any group intelligence tests that had been given previously (in over half the schools surveyed no such records were available); the children who were advanced in grade status, particularly the youngest child in the room; the brightest children according to the principal's and teachers' judgments; and those whose fathers were professional men. Utilization was made also of Ter-

⁷ L. M. Terman, *et al.*, *Genetic Studies of Genius*, Vol. I, Stanford University, Calif., Stanford Univ. Press, 1925, 19-54.

⁸ L. S. Hollingworth, *Gifted Children*, New York, Macmillan, 1926, 42-75; 223.

man's suggestions in reference to an abbreviated scale and order of tests to expedite the elimination of ineligible children. In spite of these short cuts, the search for the gifted group necessitated the individual testing or partial testing of some two hundred children scattered through seven schools,⁹ two private and five public schools in St. Louis and suburbs.

The 35 children, 18 boys and 17 girls, who constituted the normal group, were of 'normal or average' intelligence according to Terman's classification. This group had a mean chronological age of 10-0, and a mean I.Q. of 99.4 with a 10 point range, between I.Q. 95 and I.Q. 105. The writer made a preliminary survey of all nine and ten year old children in the public schools of Fayetteville, Arkansas,¹⁰ with the National Intelligence Tests, on the basis of which the most probably eligible children were selected for individual testing.

PROCEDURE AND LEARNING MATERIALS

The size of the groups used is offset by the approximately individual testing conditions of the experiments and the many records obtained on each child. Each subject learned two samples of each type of material by each of three different methods. Uniformity throughout the study was secured by the writer's conducting all the experiments and marking all the papers. The children were tested in groups, usually of three and never over five, in a separate experimental room. Strict uniformity in place and time of sittings, which always occurred during school hours, and in directions was observed throughout each experiment. All timing was done with a stop-watch. At the beginning of each experiment, the chil-

⁹ The writer wishes to acknowledge her indebtedness for their sympathetic and intelligent coöperation to Principal Rossman of the Rossman School, Miss Tillie Bergesch of the Mary Institute, Superintendent John L. Bracken of the Clayton schools, Principal Julia E. Brossard of the Forsythe School, Principal F. G. Roth of the Bellevue School, Superintendent Chas. Banks of the University City schools, Principal Rossi of the Flynn Park School, and Principal O. E. Gordon of the Delmar School.

¹⁰ To Superintendent F. S. Root of the Fayetteville public schools, Principal J. P. Perrill of the Leverette School, Principal J. F. Lawson of the Washington School and Principal Bessie Coventon of the Jefferson School, the writer wishes to acknowledge her indebtedness for their generous coöperation, without which the completion of this study would have been impossible.

dren were instructed in regard to the material to be learned and the procedure to be followed in recall and, on the respective day, the learning method to be employed. These instructions were the same *verbatim* throughout the investigation. Each experiment took eight sittings, which occurred on five school days of one week and the first three of the next. At each sitting (except the first) the sample (poem or list) learned the day before was recalled and then a new sample learned (except at the last sitting). Both learning methods and samples of the types of material were employed in a counter-balanced practice order in Experiments 1, 2 and 3. In the fourth experiment, only the learning methods were so arranged, since a change in the order of the poems would have destroyed their continuity of meaning.

Vocabularies (paired associates) and poems were the materials used. In Experiment 1, 6 lists each having 10 Turkish-English pairs were learned. The Turkish words,¹¹ which were of one or two syllables, had English equivalents which were likewise of one or two syllables. Each pair, the Turkish word to the left and the English to the right, was printed on a white cardboard, 11" x 7", in heavy black letters one inch high. For the purpose of recall, which tested forward association, the Turkish word was printed alone on the reverse side of the card. The order of presentation for recall, which remained the same throughout the experiments, was different from that of learning. Six lists, each of 10 nonsense syllable-English pairs, were used in Experiment 3. The nonsense syllables were a mixture of 0 percent and 6.67 percent association value according to Glaze's classification.¹² Each nonsense syllable, which was printed on the left of the card, was paired with a common English word of one or two syllables. For testing forward association in recall, the nonsense syllable was printed alone on the reverse side of the card.

Short poems of 12 lines constituted the learning material in Experiments 2 and 4. The first four poems used in Experi-

¹¹ W. S. Foster and M. A. Tinker, *Notes for Instructors* to accompany *Experiments in Psychology* (revised edition), New York, Henry Holt and Co., 1929.

¹² J. A. Glaze, The association value of nonsense syllables, *Ped. Sem. & J. Genet. Psychol.*, 1928, 35, 255-267.

ment² were adaptations from William Cullen Bryant's "An Autumn Walk." After making a few changes in the wording to secure simplicity, this poem yielded four units each of which had 12 lines, three verses of four lines each, and the same rhyme scheme and meter. The last two poems in the second experiment, and the six poems in the fourth experiment were taken from another long poem, "A Life Time," by Bryant. They were of the same length, verse formation and rhyme scheme as the first four poems, and similar in meter. Each subject was given the poem, typed according to the learning method, on sheets of white paper $5\frac{1}{2}'' \times 8\frac{1}{2}''$.

With the vocabulary material, in all three methods of learning, each pair of words was given ten repetitions. A presentation of a pair consisted in subjects' and experimenter's spelling out aloud together at a uniform rate the first or foreign word and then pronouncing the English equivalent. The cards were held in plain view of the children who were seated very near the experimenter. After each pair in the list had been repeated ten times, the cards were turned over and the foreign words were presented alone in a different order from that of learning. The subjects wrote the foreign words on sheets of paper, which had been previously numbered, and then the English equivalent if they could. Twenty seconds were allowed for recalling each English word, and two minutes more, after the last foreign word had been presented, for additions or changes. The time allotted was sufficient for the children to recall all they thought they could at the time since very few kept their papers the full two minutes at the end. The following three learning methods were used with the vocabulary material: the *whole method*, in which each pair was presented once in its regular order from one to ten, and this procedure was repeated ten times; a *pure part method*, in which each pair was presented ten times in succession before the next pair was shown; and a form of the *progressive part method*, in which the pairs were presented in groups of two, with one review presentation of all the pairs that had been shown before, after each new group of two was added—the first, second, third, fourth and

fifth groups were given six, six, seven, eight and nine successive repetitions respectively.

With the poetry material, six minutes were given in all three methods for the learning of each poem. At the end of that time the papers on which the poetry was typed were collected and the subjects immediately wrote what they could remember on sheets of paper on which blank lines had been numbered from one to twelve. Most of the children finished before the allotted time of 15 minutes was up, and those who kept their papers the full time were sure they could not remember more and were very willing to hand their papers in. The following three learning methods were employed: the *whole method*, in which the subject was told to 'read through the whole poem just as many times as' he could in the allotted six minutes; a *pure part method*, in which 20 seconds were given for the reading of each line, typed on a sheet of paper by itself, and finally two minutes in which to review the whole poem which appeared on the last page; and a form of the *progressive part method*, in which one minute was given for the reading of the first verse which appeared on page 1, one minute for the second verse on page 2, one minute for a review of the first and second verses on page 3, one minute for the third verse on page 4, and finally, two minutes to review the whole poem on page 5. In both part methods, the children were instructed to turn the pages on the instant of command, and always to read all the way through whatever was typed on a particular sheet. The experimenter knows that the first instruction was obeyed, and is reasonably sure that the second one was also. Throughout the experiments, these instructions were emphasized in order to secure correspondence between the methods called for and the ones actually employed. The learning methods and technique in this study, unlike those used by Winch¹³ and Sawdon,¹⁴ afford an equal amount of time for each line in all three methods used.

¹³ W. H. Winch, *op. cit.*

¹⁴ E. W. Sawdon, *op. cit.*

RETENTION PROCEDURE

In all four experiments, the material learned was again recalled after 24 hours in the same room and under the same experimental conditions as those of immediate recall. In each sitting, the test of retention always preceded the learning of the new material. At the end of the first sitting of each experiment, the experimenter said:

"I am going to ask each one of you to give me your solemn promise that you will not talk about these words (or poems) or even think about them until I tell you the experiment is over. It is more important not to talk or think about them than to know them perfectly. Do you—(asking each child in turn)—promise not to talk about these words (or poems) or even think about them? After the experiment is over, it will be all right to talk about them as much as you want. But until then—remember your promise."

It was then suggested that, if the words (or lines of the poems) should suddenly and spontaneously pop into a child's head, he should immediately think of his promise, and then about something else, such as what he planned to do during recess the next day. If his teacher, or the other children or any member of his family should ask him about the experiment, he should reply that he was learning some words and poems, but that he had promised not to talk about them until the experiment was over.

After these instructions against rehearsal had been given, the subjects were then told that the experimenter would return the next day at the same time and ask them to write all they could remember of the material they had just learned and recalled, and would then give them new material to learn. This was done in order to make the retention conditions of the first sample learned comparable to those of later samples, when the children would know that they were to be tested on the next day. Checking up on how well the promise was being carried out occurred throughout the experiment. On each of the first three days this was done on each child at the beginning of the sitting. From the children's behavior and comments, the writer judges that the promise was rather faithfully lived up to. "I didn't even tell my mother"; "I happened to think about the poem last night in bed, but right away thought that I was going to

play first base to-day"; "the girl who sits behind me asked me what we did, but I told her I couldn't tell and wouldn't tell until it was all over": are typical of many spontaneous remarks made. There is no known practical fool-proof method of preventing rehearsal, but the writer contends that the method employed here is superior to the customary one of *laissez-faire* and trusting to luck that the subjects will not review during the interval. Experimenting with school children leads one to doubt seriously whether conditions free from review ever occur 'just naturally.' It will not be hard for anyone who has worked with gifted children to believe that this group, at least, carried out the promise as faithfully as adult subjects could and would.

RESULTS

The scores of the vocabulary material are in terms of the number of correct English equivalents. If the same English word was written after two foreign words, no credit was given. The poetry scores are in terms of the number of correct lines, without taking account of spelling or punctuation. There are two types of poetry scores: V, or *verbatim* scores, in which every word was correct and the line correctly placed;¹⁵ and S, or sense scores, in which the sense of the line was given but not in the exact words. In the four experiments, each subject's record, from which the mean for the group is computed, is an average of two samples of the material learned in a counter-balanced practice order. All sigmas of the differences between learning methods were computed by the long formula,¹⁶ since the following correlations were obtained: with vocabulary, the mean correlation for learning and retention with the gifted was .52 with a range from .31 to .85, and the mean with the normal group was .37 with a range from .08 to .54; with poetry, the mean for the gifted was .70 with a range from .51 to .84, and the mean of the normal was .37 with a range from .14 to .61. In the following tables,

¹⁵ On the rare occasions when a perfect line was out of place, it was counted under sense scores.

¹⁶ Helen M. Walker, Concerning the standard error of a difference, *J. Educ. Psychol.*, 1929, 20, 53-61.

every difference which is three or more times the sigma of the difference is starred (*).

VOCABULARY MATERIAL

Experiment 1:¹⁷ Turkish-English Pairs

Learning

Inspection of Table 1 reveals that the whole method is

TABLE 1
COMPARISON OF METHODS
(A) Learning

Group	No.	Whole		Part		Whole minus Part		P/W
		Mean	S.D.	Mean	S.D.	Diff.	S.D. of Diff.	
Gifted	31..	5.06	1.55	2.53	1.27	2.53*	.29	50%
Normal	32..	2.42	1.32	1.48	.87	.94*	.20	61%
Normal/Gifted.....		48%		58%				

(B) Retention

Gifted	31..	4.12	1.49	2.17	1.36	1.95*	.26	52%
Normal	32..	1.76	1.21	.78	.74	.98*	.18	44%
Normal/Gifted.....		43%		36%				

superior to the pure-part method in both gifted and normal groups in the learning of 10 Turkish-English pairs. Moreover, this advantage of the whole method in both groups is statistically valid. This result, based on group averages, is substantiated by the fact that a much larger percentage of children in each group found the whole method more efficient (Table 2, Experiment 1). Although the whole method

TABLE 2
PERCENTAGE FINDING EACH METHOD SUPERIOR

	Experiment 1				Experiment 3			
	Learning		Retention		Learning			
	Two Method Comparison				Two Method Comparison		Three Method Comparison	
	Gifted	Normal	Gifted	Normal	Gifted	Normal	Gifted	Normal
Whole.....	97	63	88	73	78	55	34	38
Prog. P.....	..	..	..	..	..	..	47	19
Part.....	3	16	3	6	16	26	0	22
Ties.....	0	21	9	21	6	19	19	21

¹⁷ The four experiments are numbered in the order in which they were gone through.

is superior to the part in the two groups, its advantage is both absolutely and relatively greater with the gifted children. This statement is based on three lines of evidence: (1) the percentage the part method is of the whole is less with the gifted than with the normal group (Table 1); (2) the mean score of the normal group is only 48 percent of that of the gifted with the whole method, but 58 percent with the part; and (3) 34 percent more of the gifted than the normal subjects found the whole method superior (Table 2). It should be borne in mind that the differences upon which these comparisons are based are statistically valid.

After the work on the whole and pure part methods had been completed, a progressive part method was introduced to see if there might not be found a method superior to the whole. Its apparent intermediate position between the whole and part cannot be accepted since practice favored the progressive part method, making a valid comparison between it and the other two methods impossible in Experiment 1.

Retention

Table 1 shows that in the retention of 10 Turkish-English pairs after 24 hours the whole method is reliably superior to the pure part in both gifted and normal groups. This result is substantiated by the percentage of subjects finding each method superior (Table 2, Experiment 1, Retention). The advantage of the whole method in retention with the gifted is absolutely, but not relatively, greater than with the normal subjects, as it was in learning. Two facts indicate this greater relative advantage of the whole with the normal group: (1) the percentage the part is of the whole method is 52 percent with the gifted and only 44 percent with the normal (Table 1); and (2) the mean score of the normal group is a larger percentage of the gifted with the whole method than with the part (43% vs. 36%). This result is explained by a comparison of the two groups in terms of the percentage the retention score is of the learning score: with the gifted children the percentage of retention varies little with the learning method (81% with the part and 85% with the whole

method), whereas with the normal group, the whole method yields a greater percentage of retention than the part (72% vs. 52%)

Experiment 3: Nonsense Syllable-English Pairs

Learning

In Experiment 3, since the whole, progressive part and pure part methods were employed in a counter-balanced practice order, and each method had had equal previous practice, valid comparisons can be made between all three learning methods. The lists of nonsense syllable-English pairs used as learning material proved to be more difficult than lists of equal length of Turkish-English pairs employed in the first experiment.

TABLE 3
COMPARISON OF METHODS
(A) *Learning*

Group	No.	Whole		Prog. Part		Part	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
Gifted	32..	3.51	1.60	3.60	1.80	2.03	1.24
Normal	31..	1.58	.74	1.17	.90	1.09	.92
Normal/Gifted.....		45%		33%		54%	

(B) *Retention*

Gifted	32..	2.03	1.37	1.68	1.49	1.12	.95
Normal	31..	.69	.65	.66	.66	.33	.51
Normal/Gifted.....		34%		39%		29%	

The mean scores given in Table 3 show that the part method was again inferior to both the whole and progressive part in both groups. With the gifted children there is a slight superiority of the progressive part over the whole, while with the normal group the whole method appears the most efficient of all three methods. Table 4, however, reveals that not all of these differences are reliable. With the normal group, the chances are 99 out of 100 that the whole is superior to both the progressive part and pure part methods,

TABLE 4
DIFFERENCES BETWEEN METHODS

	Learning				Retention			
	Gifted		Normal		Gifted		Normal	
	Diff.	S.D. of Diff.	Diff.	S.D. of Diff.	Diff.	S.D. of Diff.	Diff.	S.D. of Diff.
Whole-Prog. P.	-.09	.30	.41	.14	.35	.29	.03	.12
Whole-Part.	1.48*	.27	.49	.18	.91*	.20	.36	.13
Prog. P.-Part.	1.57*	.26	.08	.22	.56	.24	.33	.13

but the intermediate position of the progressive part is not statistically validated. With the gifted group, the part method is reliably inferior to both the whole and progressive part methods between which there is no reliable difference.

These results, based on mean scores, are substantiated by the fact that (Table 2, Experiment 3), with the gifted children, a larger percentage found the progressive part superior to the whole, but not one subject showed a superiority of the part method, while with the normal children, the percentage finding the whole most efficient is about twice as large as that finding either the progressive part or part method superior. Between the latter two methods there is practically no difference.

Again, as in Experiment 1, the advantage of the whole method over the part is both absolutely and relatively greater with the gifted than with the normal subjects. Its greater relative superiority is shown in: (1) the smaller percentage the part method is of the whole with the gifted (P/W equals 57%) than with the normal (P/W equals 69%); (2) the smaller percentage the mean score of the normal is of the gifted with the whole method than with the part (Table 3); and (3) that 23 percent more of the gifted than of the normal found the whole method superior to the part (Table 2, Experiment 3, Two Method Comparison). The same three lines of evidence indicate a greater relative advantage also of the progressive part over the pure part method with the gifted group.

Retention

In Experiment 3, where the practice factor had been controlled, the progressive part method assumes an apparently intermediate position with both groups in the retention of nonsense syllable-English pairs after 24 hours (Table 3). Table 4, however, shows that this position is not statistically validated. The superiority of the whole over the part method with the gifted group is the only reliable difference, although, with the normal group, the chances are 99 out of 100 that the whole method is superior to the part, and 98 out of 100 that the progressive part is also superior to the part. The advantage of the whole over the part method in both groups, and the superiority of the progressive part over the part with the normal group are seen in the percentages of children finding each method superior which are given in Table 5. As was found in Experiment 1, the advantage of the whole over the part is absolutely greater with the gifted group (Table 4), but relatively greater with the normal subjects, since: (1) the percentage the part is of the whole method is 55 percent with the gifted and only 48 percent with the normal group; and (2) the mean score of the normal group is 34 percent of that of the gifted with the whole and only 29 percent with the part (Table 3). Although these percentage differences are not large, the score differences upon which they are based are all reliable. The same lines of evidence indicate a relatively greater advantage of the progressive part over the part method with the normal group than with the gifted. The same conditions with respect to

TABLE 5

Method	Percentage Finding Each Method Superior					Percentage of Retention	
	Two Method Comparison			Three Method Comparison		Retention/Learning	
	Gifted	Normal		Gifted	Normal	Gifted	Normal
Whole.....	72	55	..	44	32	58	44
Prog. P.....	..	..	55	28	30	47	56
Part.....	9	13	19	6	6	55	30
Ties.....	19	32	26	22	32	..	..

percentage of retention are found in this experiment as were found in Experiment 1: with the gifted children there is little difference between the whole and part methods in percentage of retention (Table 5), whereas, with the normal subjects, the percentage of retention is considerably greater with the whole, and likewise greater with the progressive-part method than with the part.

SUMMARY OF RESULTS ON VOCABULARY LEARNING

1. With two types of vocabulary material, lists of 10 Turkish-English pairs and 10 nonsense syllable-English pairs, the whole method is reliably superior to the pure part method with both gifted and normal groups.

2. With both types of vocabulary, this advantage of the whole method over the pure part is both absolutely and relatively greater with the gifted than with the normal children.

3. With nonsense syllable-English pairs, the gifted show a reliable superiority of the progressive part method over the pure part, but no valid difference between the whole and progressive part methods; while, with the normal group, the whole method is superior to the progressive part, but there is no reliable difference between the two part methods.

4. This advantage of the progressive part over the pure part with nonsense syllable-English pairs is both absolutely and relatively greater with the gifted than with the normal children.

5. The greater relative superiority of the whole and progressive part methods over the pure part with the gifted group demonstrates that the I.Q. is a factor in the relative efficiency of these three learning methods.

SUMMARY OF RESULTS ON THE RETENTION OF VOCABULARY

1. In retention of both Turkish-English and nonsense syllable-English pairs after an interval of 24 hours, the whole method is reliably superior to the part in both gifted and normal groups. With the nonsense syllable-English vocabulary the apparent intermediate position of the progressive

part method is not statistically validated with the gifted group, but the chances are 98 out of 100 that it is superior to the part method with the normal subjects.

2. The advantage of both the whole and progressive part methods over the part is relatively greater with the normal children, although absolutely greater with the gifted children.

3. The percentage of retention of both types of vocabulary is approximately the same with the whole and part methods with the gifted, but with the normal subjects there is a considerably greater percentage of retention with the whole method than with the part, and also with the progressive part than with the part method with the nonsense syllable-English pairs.

POETRY MATERIAL

Experiment 2: 12 Lines of Poetry

Learning

In Table 6, small differences between the whole and progressive part methods appear in both gifted and normal groups in both *verbatim* and *verbatim* plus sense scores. None of these differences, however, is reliable. The percentages of children finding each method superior present further evidence of the lack of pronounced differences between the two methods.

TABLE 6
COMPARISON OF METHODS

	V Scores				V + S Scores			
	Gifted		Normal		Gifted		Normal	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Whole.	4.25	2.31	.45	.50	7.08	3.07	1.82	.99
Prog. P.	4.41	2.91	.39	.44	7.56	3.42	1.58	.78
	Diff.	S.D. of Diff.	Diff.	S.D. of Diff.	Diff.	S.D. of Diff.	Diff.	S.D. of Diff.
W. minus Prog. P.	-.16	.39	.06	.10	-.48	.47	.24	.20

After the work on these two methods had been completed, a third, the pure part, was introduced. The relative position

of this method cannot be assigned because of the practice factor in its favor, although, with this advantage, it is superior to both the whole and progressive part in both groups.

Retention

In the retention of 12 lines of poetry after 24 hours, the differences between the whole and progressive part methods in both groups with both types of scores are very small, being less than half a line, and are unreliable as Table 7 shows. This lack of significant differences between the two methods is apparent also in the percentage of subjects finding each method superior. The percentage of retention (Table 7) with

TABLE 7

Group	No.	Scores	Whole		Prog. Part		Whole-Prog. P.		Percentage of Retention	
			Mean	S.D.	Mean	S.D.	Diff.	S.D. of D.	W.	Prog. P.
Gifted . . . 30..		V	3.30	2.53	3.58	3.09	-.28	.38	78	81
		V + S	5.73	3.68	5.88	3.57	-.15	.48	81	78
Normal . . 32..		V	.11	.17	.03	.14	.08	.04	24	7
		V + S	.77	1.13	.41	.59	.36	.20	42	26

the gifted group is approximately the same for the two methods with both types of scores, but the normal group shows a tendency to have a greater percentage of retention with the whole method with both types of scores.

Experiment 4: 12 Lines of Poetry

Learning

Valid comparisons can be made between the three methods employed in the fourth experiment, since they were used

TABLE 8
COMPARISON OF METHODS

Group	No.	Scores	Whole		Prog. Part		Part	
			Mean	S.D.	Mean	S.D.	Mean	S.D.
Gifted 31....		V	4.80	2.65	4.98	2.50	4.59	2.54
		V + S	8.38	2.65	8.81	2.59	8.18	2.64
Normal 31....		V	.66	.45	.56	.60	.65	.62
		V + S	2.60	1.18	2.54	1.13	2.64	1.29

in a counter-balanced practice order and had had equal previous practice. The mean *verbatim* scores, as well as the mean composite scores, *verbatim* plus sense scores, in Table 8 show only small differences, all in fractions of a line, between the three methods within each group. The sigmas of the differences computed for the *verbatim* scores were all larger than their differences, while Table 9 shows that there are

TABLE 9
V + S SCORES

	Learning				Retention					
	Gifted		Normal		Gifted			Normal		
	Diff.	S.D. of D.	Diff.	S.D. of D.	Means	Diff.	S.D. of D.	Means	Diff.	S.D. of D.
W.-Prog. P....	-.43	.34	.06	.22	6.80-7.25	-.45	.44	1.13-1.16	-.03	.20
W.-Part.	.20	.36	-.04	.22	6.80-6.45	.35	.54	1.13-.97	.06	.20
Prog. P.-P....	.63	.46	-.10	.25	7.25-6.45	.80	.47	1.16-.97	.09	.18

likewise no reliable differences within each group in the composite scores. This lack of significant differences between the three methods is also apparent in the percentage of subjects finding each method superior.

Retention

The results here with the three methods are the same as those in Experiment 2: there are no reliable differences between the whole, progressive part and part methods in either group with either type of score. This result appears in both the mean scores and in the percentage of children finding each method superior. Since both types of scores give the

TABLE 10
PERCENTAGE OF RETENTION

	Gifted		Normal	
	V	V + S	V	V + S
Whole.	85	81	32	43
Prog. P.	72	82	18	46
Part.	72	79	15	36

same results, only the data in terms of the mean $V + S$ scores are presented here in Table 9. The percentage of retention (Table 10) with V scores show a tendency for the whole method to be superior to the other two methods in both groups. With the composite scores, there is practically no difference between the three methods with the gifted, but a tendency for the part method to be inferior to both the whole and the progressive part with the normal group.

SUMMARY OF RESULTS ON POETRY MATERIAL

1. Under the experimental conditions employed, there are no valid differences between the whole, progressive part and part methods in either group with either V or $V + S$ scores in the learning of 12 lines of poetry, or in the retention after a 24 hour interval.

2. In the percentage of retention, the normal group shows more variation than the gifted between the three methods, mainly in the direction of an advantage of the whole. Such variations which appear, however, can be considered only as indicative of possible tendencies, since all the differences between the three methods in learning and retention are unreliable.

INTELLIGENCE AND LEARNING

The comparison of the normal group with the gifted in learning and retention scores, irrespective of learning method, is significant, although of incidental importance with respect to the whole-part problem. In Table 11 the differences between the two groups are presented in terms of the percentage the mean score of the normal is of the mean score of the gifted subjects. All of these differences are reliable, since they are from 3 to 12 times their sigmas. The superiority of the gifted group is apparent throughout the table, being greater with poetry material than with vocabulary, and greater in retention than in learning. The average percentages for the three methods in both of the two experiments with each type of material are as follows: with vocabulary, the normal children learned 46 percent, and retained but 35 percent, of what the gifted learned and retained; the com-

TABLE 11
COMPARISON OF GROUPS IN MEAN SCORE OF NORMAL
MEAN SCORE OF GIFTED

Learning						Retention					
Whole		Prog. P.		Part		Whole		Prog. P.		Part	
Vocabulary											
I. 48	3. 45	I. 39	3. 33	I. 58	3. 54	I. 43	3. 34	I. 29	3. 39	I. 36	3. 29
Poetry. V Scores											
2. 11	4. 14	2. 9	4. 11	2. 19	4. 14	2. 3	4. 5	2. .8	4. 3	2. 4	4. 3
Poetry. V + S Scores											
26	31	21	28	34	32	13	16	7	16	10	15

posite poetry score of the normal group was 29 percent of that of the gifted in learning and 13 percent in retention; while in terms of *verbatim* scores, the normal subjects were only 13 percent of the gifted in learning and but 3 percent in retention. In other words, in *verbatim* learning of poetry,

TABLE 12
COEFFICIENTS OF VARIATION

Method	Group	Learning				Retention			
		Vocabulary		Poetry *		Vocabulary		Poetry *	
		1	3	2	4	1	3	2	4
Whole.....	Gifted	31	45	54	55	36	67	77	73
	Normal	54	47	111	68	69	94	154	260
Prog. P.....	Gifted	36	50	66	50	47	89	86	71
	Normal	47	77	112	107	83	100	466	220
Part.....	Gifted	50	61	39	55	62	85	64	79
	Normal	59	84	78	95	95	154	193	171

* V Scores.

where the difference is greatest, the gifted children learned about 8 times, and retained about 33 times, as much as the normal children. Not only did the gifted group learn and retain more, both absolutely and relatively since they show a consistently greater percentage of retention, but their variability, as measured by the coefficient of variation (Table 12), was less than that of the normal group in every comparison of the two groups in the three methods in all four experiments. This difference in variability parallels the difference in size of the scores, being greater with poetry material than with vocabulary, and greater in retention than in learning.

INTERPRETATION OF RESULTS

Vocabulary Learning

The results of this study, *i.e.* the reliable superiority of the whole method over the pure part (with both groups and with both types of vocabulary), agree with those of Neumann¹⁸ and Brown,¹⁹ the only other two investigators who used the whole and pure part methods with paired associates under partial learning conditions. As was pointed out in the Introduction, Neumann found the whole method consistently superior to the pure part with five nine- and ten-year old subjects in the learning and retention of lists of seven French-German pairs when each list was given 15 repetitions, or the same amount of time (4'-15'') with each method, and with one nine-year old child in the learning and retention of lists of eight Latin-German pairs when each list was given 10 repetitions. Brown found the whole method reliably superior to the pure part with 511 college students in the learning of lists of 12 English words paired with two-syllable nonsense words when each list was given 12 repetitions with the whole method and 13 with the part. Neumann tested reverse association, while in Brown's, as in this study, forward association was tested.

The probable explanation of this superiority of the whole method over the pure part in the partial learning of lists of

¹⁸ G. Neumann, *op. cit.*

¹⁹ Warner Brown, Whole and part methods in learning, *J. Educ. Psychol.*, 1924, 15, 229-233.

not over 12 pairs is the greater distribution of practice for each pair afforded by the whole method: repetitions of each pair in the whole method are separated by the time taken to recite the rest of the list, while, in the part, they occur in immediate succession. This explanatory principle of distribution of practice for each pair has experimental support in the data of three of Ephrussi's series,²⁰ in which three subjects consistently show an increased efficiency in the learning of lists of five and six pairs of nonsense syllables with an increase in the distribution of repetitions for each pair. The whole method (which had been found inferior to her distributed part method) was improved by the distribution relatively more than the part, since the differences between the two methods decreased under the conditions of greater distribution. It is unfortunate that Ephrussi did not employ a pure part method so that her experiment could be directly compared with Neumann's and Brown's investigations and with this study. However, her results at least indicate that, under certain experimental conditions, both the absolute and relative efficiency of methods of learning paired associates vary directly with the amount of distribution of practice given each pair.

What has been said in regard to the distribution of practice as an explanatory principle of the superiority of the whole method over the pure part will apply also to the superiority of variations of the part method (Neumann's mixed method and the progressive part in this study) over the pure part, in which the distribution, while not as great as in the whole method, is greater than in the pure part.

Vocabulary Retention

The greater relative advantage in vocabulary retention of the whole over the part method with the normal than with the gifted children is a result, as was pointed out before, of the fact that the normal group shows a greater percentage of retention with the whole method (which had been the more efficient method in learning) than with the part, while the

²⁰ P. Ephrussi, *Experimentelle Beiträge zur Lehre vom Gedächtnis*, *Zsch. f. Psychol.*, 1904, 37, 171-177.

percentage of retention with the gifted group is practically the same for all learning methods. However, this difference in percentage of retention in the learning methods with the normal subjects is probably not a true difference, as the following analysis will indicate, but an artifact resulting from the greater number of low scores with the less efficient part method. An analysis of the normal children's scores with the whole and part methods in learning and retention of vocabulary gives the following results: In Experiment 1, with the part method, 25 percent of the children did not learn even one of the 10 Turkish-English pairs, whereas only 9 percent had such a low score with the whole method. (Since not one of these subjects with either method recalled one pair, *i.e.* none showed reminiscence) the greater percentage of retention with the whole method (72%) than with the part (52%), based on the mean score of the group, is in part, at least, due to the fact that 14 percent more of the group with the whole method learned enough to give them a chance to recall any of the material. The same condition is found in Experiment 3, since 39 percent of the children with the part method, compared to 26 percent with the whole, did not learn even one of the 10 nonsense syllable-English pairs.

Poetry Learning and Retention

In considering the reliable differences found between the methods in both groups with vocabulary material compared to the lack of any such reliable differences with the poetry material, the factor of practice with learning methods previous to the experiment must be kept in mind. Apparently the children in both gifted and normal groups had had practically no experience with learning of the paired associate type, since not one, when questioned on the first day of the experiment with vocabulary material, could remember having learned lists at all similar to the test material. Obviously, then, these subjects did not come to the experiment with firmly established habitual learning methods. The condition was quite otherwise with the poetry material. Questioning each subject on the first day poetry material was used gave

the following results: not one of the normal group habitually employed the whole method—62 percent learned ‘verse by verse’ and 38 percent learned ‘line by line’; of the gifted group, 68 percent learned ‘verse by verse,’ 19 percent learned ‘line by line,’ while only 13 percent by the whole method. All but one of these subjects who habitually used the whole method did it because they had been previously instructed to do so by some teacher in a lower grade. The practice factor is thus against any superiority of the whole method with poetry learning, while the reason for the lack of superiority of either part methods lies probably in the form of the three learning methods used: the two part methods differed from the whole in only the first two thirds of the time allotted for learning, since the last third was devoted to complete readings of the entire poem.

SUMMARY

A study of the learning and retention after 24 hours of two types of material, lists of 10 paired associates and poems of 12 lines, by two groups, in each of which were 30 nine- and ten-year old school children, a gifted group with a mean I.Q. of 151 and a normal group with a mean I.Q. of 99, with three learning methods, whole, progressive part and pure part, gave the following results:

I. The whole method is reliably superior to the pure part in the learning and retention of both types of vocabulary with both gifted and normal groups. In learning, this advantage of the whole is relatively, as well as absolutely, greater with the gifted group. With poetry material, there are no reliable differences between the two methods in learning or retention with either group.

II. The only reliable difference between the whole and progressive part methods with either type of material is the superiority of the whole with the normal group in the learning of the nonsense syllable-English pairs.

III. The only reliable difference between the progressive part and pure part methods is the superiority of the progressive part with the gifted group in the learning of the nonsense syllable-English vocabulary.

IV. Irrespective of learning methods, the gifted group learned and retained more, both in absolute amount and in percentage of retention, and are less variable than the normal group, with both types of material.

CONCLUSIONS

I. The I.Q. is a factor conditioning the relative efficiency of the whole, progressive part and pure part methods in learning. Its efficacy as a factor is apparent, at least, in a comparison of gifted and normal children.

II. Type of learning material is also a factor, which, however, may be a function of the amount of practice and the kind of part methods used.

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